



THE PEST STATUS OF *PERIPLANETA FULIGINOSA* (SERVILLE)  
(DICTYOPTERA: BLATTIDAE) IN CHINA

WILLIAM H. ROBINSON AND NONGGANG BAO

Urban Pest Control Research Center, Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

---

*Abstract.*—There are approximately 19 pest cockroach species in China. The most common household pests include the German cockroach, *Blattella germanica* (L.) and six *Periplaneta* species, including the smokybrown cockroach, *P. fuliginosa* (Serville). The pest status of *P. fuliginosa* in residences was determined by evaluating the attitudes and knowledge of apartment residents in Hangzhou, China that regularly experience this cockroach as a household pest. The questionnaire-survey indicated that a mean of 5 cockroaches was seen per day in the apartments. However, the residents considered the presence of 2 per day a problem. A majority of residents considered cockroaches more serious than a leaky faucet or a broken window, but considered having mice more serious than having cockroaches. Approximately 8% of the people questioned linked household cockroaches to the spread of disease. The apartment residents reported spending an average of 0.38Y (\$0.11) (range 0–1.5Y) per month on cockroach control. Those interviewed in April were willing to spend an average of 2.65Y (\$0.72) (range 0–5.5Y), and those interviewed in August were willing to spend 5.27Y (\$1.44) (range 0–7.5Y) per month for elimination of their cockroach infestation. The attitudes and knowledge of cockroach pests by urban residents in China was similar to those in the U.S.

*Key Words:* cockroach pest status, China, survey

---

There are approximately 19 cockroach species that are pests in households in the People's Republic of China (Table 1). The major pest species are *Blattella germanica* (L.), and six *Periplaneta* species: *P. americana* (L.), *P. australasiae* (F.), *P. brunnea* (Burmeister), *P. fallax* (Bienko), *P. fuliginosa* (Serville), and *P. japonica* Karny. The German cockroach, *B. germanica*, occurs primarily in locations that are regularly heated in the winter, such as hotels, restaurants, and transportation vehicles (Woo and Guo 1984). *Periplaneta americana* and *P. fuliginosa* are more generally distributed, and occur in single- and multi-family dwellings, hotels, restaurants, stores, and food processing plants (Woo 1982). *Periplaneta*

*japonica* is a serious household pest in northeastern China (Woo 1982). The oriental cockroach, *Blatta orientalis* L., has been recorded as a pest in Beijing, Xingjiang, and Yunnan provinces (Woo 1987). *Pycnoscelus surinamensis* (L.) has been reported from Yunan, Guangdong, and Fujian provinces (Woo 1987). *Eupolyphaga sinensis* Walker is a household pest in northern, central, and southeastern provinces (Woo 1987). *Eupolyphaga sinensis*, *Polyphaga plancyi* Bolivar, and *Opisthoblatta orientalis* Burmeister are often used in traditional Chinese medicine (Woo 1987).

The urban population of the People's Republic of China is approximately 230 million. Although urban residents are only 22%

Table 1. The cockroaches species that are known to be household pests in China.

Species	Reference
Family Blattidae	
<i>Periplaneta americana</i> (L.)	Woo 1982
<i>Periplaneta australasiae</i> (F.)	Woo 1982
<i>Periplaneta brunnea</i> (Burmeister)	Woo 1982
<i>Periplaneta fallax</i> (Bienko)	Woo 1982
<i>Periplaneta fuliginosa</i> (Serv.)	Woo 1982
<i>Periplaneta japonica</i> Karny	Woo 1982
<i>Blatta orientalis</i> L.	Woo 1987
<i>Hebardina concinna</i> (Haan)	Chen et al. 1986
<i>Neostylopyga rhombifolia</i> (Stoll)	Woo 1987
Family Blaberidae	
<i>Pycnoscelus surinamensis</i> (L.)	Woo 1987
Family Blattellidae	
<i>Blattella germanica</i> (L.)	Woo and Guo 1984
<i>Blattella latistriga</i> (Walker)	Woo and Guo 1984
<i>Blattella lituricollis</i> (Walker)	Woo and Guo 1984
<i>Parcoblatta kyotensis</i> Asahina	Woo 1987
Family Corydiidae	
<i>Eupolyphaga yunnanensis</i> Kirby	Woo 1981
<i>Eupolyphaga sinensis</i> Walker	Woo 1987
<i>Eupolyphaga thibetana</i> Chopard	Woo 1981
<i>Polyphaga plancyi</i> Bolivar	Woo 1987
Family Epilampridae	
<i>Opisthoplata orientalis</i> Burmeister	Woo 1987

of the total population, this segment of society lives in more confined and crowded conditions than the rural population, and is often exposed to vertebrate and invertebrate pests. Information to homemakers on the biology and control of pests in urban areas is provided primarily by the Sanitation and Anti-epidemic Stations in each of the provinces and major cities.

Data on cockroach species biology and habits, distribution, aspects of chemical and non-chemical control, disease transmission,

and insecticide resistance in China are available (Woo 1982, 1987, Woo and Guo 1984, Li and Nie 1984). However, there is little information on the attitudes and knowledge of urban residents toward cockroach pests. These data are important for the design and implementation of urban pest management programs (Zungoli and Robinson 1984).

The objective of the research presented here was to determine the pest status of the smokybrown cockroach, *P. fuliginosa*, by evaluating the attitudes and knowledge of residents that regularly experienced this cockroach as a household pest.

#### MATERIALS AND METHODS

The study was conducted in April and August 1985, in the city of Hangzhou, Zhejiang Province, China. The survey (Table 2) consisted of 14 questions; of which nearly all were open ended, i.e. responses were not chosen from a list offered by the interviewer. The topics covered in the questions included, what causes cockroaches, what is the best method of control, the number of cockroaches seen daily, where in the apartment cockroaches are seen, the amount of money spent on cockroach control, and the amount the residents were willing to spend on control. The age of the person interviewed and the number of years living in the apartment were also recorded.

The survey method consisted of one interviewer questioning individual residents in their apartments. Five interviewers conducted the surveys. A total of 105 people were interviewed; 51 in April, when cockroaches were not active outside or inside the apartments; and 54 in August, when cockroaches were active inside and outside the apartments.

The survey sites were apartment buildings adjacent to Zhejiang Agricultural University. The apartment buildings were constructed within the last five years. The residents were primarily workers from nearby factories. The monthly earning per fam-

Table 2. The questions in the interviews conducted in Hangzhou, China to determine the pest status of *Periplaneta fuliginosa*.

General Opinion of the Cockroach Problem.		
Q. Are roaches a serious problem?		
A. Yes—67% (April), 94% (August); No—33% (April), 6% (August).		
Q. How many roaches do you see per day (when you have them as a pest)?		
A. $\bar{x}$ 4.5 (April), $\bar{x}$ 5 (August).		
Q. Where do you see roaches in your apartment?		
A. Bedroom—63%; Bathroom—54%; Kitchen—98%		
Pest Status of <i>P. fuliginosa</i> .		
Q. Which of these do you think is a worse problem?		
A.	April	August
Roaches	65%	93%
Faucet leak	25%	6%
Equal	10%	2%
Roaches	63%	67%
Broken window	31%	30%
Equal	6%	4%
Roaches	43%	52%
Trash in hall	57%	44%
Equal	—	4%
Roaches	33%	4%
Mice	63%	87%
Equal	4%	9%
Q. What bothers you the most about having cockroaches?		
A.		
Found around food—	53%	
Found everywhere—	10%	
Cockroach feces—	10%	
Spread disease—	8%	
Smell—	8%	
Other—	12%	
Q. If you are visiting someone's apartment and you see 20 (15, 10, 5, 2) roaches, would you think there was a problem with cockroaches?		
A. 20 roaches considered a problem—97% yes		
15 roaches considered a problem—97% yes		
10 roaches considered a problem—97% yes		
5 roaches considered a problem—88% yes		
2 roaches considered a problem—59% yes		
Knowledge of the Cause and Control of Cockroaches.		
Q. What do you think causes roaches?		
A.		
Food and filth—	43%	
Don't know—	28%	
Fly into apt.—	10%	
Other—	19%	

Table 2. Continued.

Q. What is the best way to control roaches?	
A. Insecticides—	48%
Sanitation—	29%
Don't know—	14%
Other—	9%
Economic Impact of Cockroaches.	
Q. Did you purchase insecticides to control roaches?	
A. Yes—87%, No—13%	
Q. How much did you spend on roach control last year (summer)?	
A. $\bar{x}$ spent—0.38pY	
Q. How much are you willing to spend for elimination?	
A. $\bar{x}$ 2.65Y (April)	
$\bar{x}$ 5.27Y (August)	

ily (3–4 persons) was estimated to be between 150Y and 300Y.

All data were coded and analyses were performed using Statistical Analysis Systems programs (SAS Institute 1985). Statistical procedures included analysis of variance, linear regression, and Chi-square contingency analysis. For all analyses, an alpha level of significance was set at 0.05.

## RESULTS AND DISCUSSION

The survey questions are not presented in the sequence they occurred on the survey form, but are grouped to provide easier discussion of the results. Three questions were not evaluated; they pertained to the smell of insecticides, the rating of cockroach control, and the prospect of eliminating all cockroach pests.

Background information.—The mean number of years the residents lived in their apartment was 4.5 (median 3 yrs). The number of years of residence coincides with the age of the apartment buildings: most of the people surveyed were the first occupant of the apartments in the buildings.

General opinion of the cockroach problem.—The presence of *P. fuliginosa* in the apartments was considered a serious problem by the majority of the people ques-

tioned in either April ( $\chi^2 = 5.78$ ;  $df = 1$ ;  $P < 0.025$ ) or August ( $\chi^2 = 38.72$ ;  $df = 1$ ;  $P < 0.005$ ). In August, a larger percentage of residents (94%) considered cockroaches a serious problem than residents questioned in April (67%). Residents questioned in April reported they had a mean of 4.5 cockroaches per day in their apartment in the summer; and residents questioned in August reported a mean of 5.0 cockroaches per day in their apartment. Although residents were able to recall the approximate number of cockroaches in their apartments during the summer, their perception of the seriousness of the problem was influenced by whether cockroaches were present at the time or not. Residents questioned during the time cockroaches were actually present in their apartment (August) indicated they were a serious problem more often than when questioned during the time cockroaches were absent (April). Thoms and Robinson (1986) reported that observations by apartment residents on the distribution and seasonal abundance of domiciliary cockroaches can be accurate.

The reason residents consider the presence of approximately 5 cockroaches per day to be a serious problem may be due to the distribution of the cockroaches in the apartment. Cockroaches were reported throughout the apartments; 98% of the respondents reported cockroaches in the kitchen, and 63% reported cockroaches in the bedroom. Five cockroaches in an apartment may be considered few when compared to German cockroach infestations of similar structures (Akers and Robinson 1981). However, *P. fuliginosa* is the primary household cockroach pest in Hangzhou (Bao, unpublished data), and the residents have little or no experience with cockroach species that have a small body size or occur in large numbers.

Pest status of *P. fuliginosa*. Several situations, such as trash in the hall, or other pests, such as mice, were compared with a cockroach infestation. The "equal" re-

sponses were not more than 5% of the total responses, and these responses were excluded from the statistical analysis. A majority of residents considered cockroaches much more serious than a leaky faucet, or a broken window (April  $\chi^2 = 3.38$ ;  $df = 1$ ;  $P < 0.025$ ; August  $\chi^2 = 5.78$ ;  $df = 1$ ;  $P < 0.025$ ). Responses were nearly evenly divided on the comparison of cockroaches and the presence of trash in the hall. Sixty-three percent of the residents questioned in April considered mice more serious than cockroaches, and 87% of those questioned in August considered mice more serious.

Fifty-three percent of the people questioned reported being bothered by the presence of cockroaches around food, and some respondents (8%) linked cockroaches to the spread of disease. When responding to a question on distribution, 98% reported cockroaches in their kitchens. The response "they are everywhere" may indicate the difficulty people have in expressing what they disliked about cockroaches (Wood et al. 1981). The fecal pellets of *Periplaneta* species are large (2.5–4.5 mm), and can be scattered in cabinets and storage areas. Residents (10%) reported disliking the presence of *P. fuliginosa* fecal pellets in their apartments.

Fifty-nine percent of the people questioned considered the presence of just two cockroaches (in the hypothetical situation) to represent "a problem." The attitudes indicated in the questions regarding the number of cockroaches that constitute "a problem" indicate that pest control may not be considered successful unless the number of cockroaches seen per day is at least less than two. When there are severe infestations, maintaining low numbers of cockroaches may be difficult. Robinson and Zungoli (1985) suggested that the expectations of urban residents for cockroach elimination may need to be tempered by pest control personnel and education programs.

Knowledge of the cause and control of cockroaches.—When asked about the cause of cockroach infestations, a large majority

(43%) of the residents considered food scraps and filth to be the most important ( $\chi^2 = 23.76$ ;  $df = 3$ ;  $P < 0.005$ ). *Periplaneta fuliginosa* is capable of flying short distances, and 10% of the residents reported cockroaches flying into their apartments from the outside as the cause of their apartments being infested. Nearly one-third (28%) of the residents did not know the cause of cockroach infestations. When asked what was the best way to control cockroaches, only 29% of the residents mentioned sanitation, whereas 48% considered insecticides the best method of control.

Economic impact of cockroaches.—Evidence of the importance of the cockroach infestations was found in the amount of money the residents reported spending for control, and on the amount they were willing to spend for elimination. Residents reported spending 0.38Y (\$0.11) (range 0–1.5Y) per summer for cockroach control, but they were willing to spend considerably more, from 2.65Y (\$0.72) (range 0–5.5Y) for those questioned in April to 5.27Y (\$1.44) (range 0–7.5Y) for those questioned in August for elimination of the problem. The 0.38Y per summer probably represents the purchase of several packets of cockroach control tablets (boric acid) for the four months that *P. fuliginosa* are present in apartments. The amount of money the residents reported they were willing to spend for cockroach elimination was considerable, and varied according to when they were questioned (April or August). At the time (August) cockroaches were most common in their apartments, the people questioned were willing to spend nearly twice the amount of money for control than what they stated they were willing to pay for control when cockroaches were not present. Sawyer and Casagrande (1983) stated that the severity of a pest problem can be determined by assessing the amount of money a person is willing to spend to alleviate the problem.

The results of the survey of the apartment residents in Hangzhou provide considerable

information on the pest status of *P. fuliginosa*. Although the time this cockroach species is active inside apartments is limited to approximately one-third of the year, the residents considered it a serious household pest. The mean number of cockroaches the residents reported seeing was only five. The residents reported that the presence of just two cockroaches would be considered a problem. However, the apartments are small and there is considerable opportunity for interaction between cockroaches and people. Thoms and Robinson (1986) reported urban apartment residents intolerant of *B. orientalis* when found indoors. They reported that 82% of the apartment residents questioned in Roanoke, VA considered two oriental cockroaches indoors a problem, and 96% considered five a problem.

Thoms and Robinson (1986) reported that the low tolerance of oriental cockroaches reported by urban apartment residents may result from the size of the oriental as compared with the much smaller German cockroach, and the perception that the oriental cockroach is an invader from outdoor habitats. The residents in this study had little or no experience with infestations of small-sized cockroaches, such as the German cockroach, because this species is not a household cockroach pest in Hangzhou (Bao, unpublished data).

The response of the residents of Hangzhou to the questions comparing cockroaches to other household pests (mice), and to household problems (leaky faucet) was very similar to the responses by U.S. residents to similar questions. Wood et al. (1981) reported that urban apartment residents considered German cockroaches much more important than a broken window, leaky faucet, or trash in the yard, and they were nearly evenly divided in their opinions of cockroaches and mice. In the results reported here, the responses of the Hangzhou residents were nearly the same as those reported in the United States.

This information collected in this survey

can provide a basis for the education component of a cockroach pest control program (Robinson and Zungoli 1985). The responses to the questions concerning the causes and control of *P. fuliginosa* infestations indicate a need for some specific information. The dependence on chemical control for cockroaches is apparent by the large percentage (48%) of the residents that considered insecticides to be the best way to control these pests. Robinson and Zungoli (1985) reported a significant change in resident understanding of cause and control of household cockroaches as a result of an education program.

#### ACKNOWLEDGMENT

We appreciate the help of Wan Xing-sheng, Zhu Kunyan, Chen Yi, and Zou Wanhe in conducting the interviews of the residents. Patricia A. Zungoli, Department of Entomology, Clemson University, reviewed and improved the manuscript.

#### LITERATURE CITED

- Akers, R. C. and W. Robinson. 1981. Spatial patterns and movement of German cockroaches in urban low-income apartments (Diptera: Blattellidae). *Proc. Entomol. Soc. Wash.* 83: 168-172.
- Chen, P., C. Huang, P. Su, and J. Huang. 1986. Report on cockroach species, biology and habits in Nanning, Guangxi, pp. 16-24. *In* Z. Huang, ed., *Studies on Household Cockroaches and Bedbugs. Series 3., Medical Animal Pest Control* 2(4).
- Li, Jie and Nie Wei-qing. 1984. Bionomics of *Te-trastichus hagenowii* parasitizing in the ootheca of *Periplaneta fuliginosa*. *Acta Entomologica Sinica* 27: 406-409.
- Robinson, W. H. and P. A. Zungoli. 1985. Integrated control program for German cockroaches (Diptera: Blattellidae) in multiple-unit dwellings. *J. Econ. Entomol.* 78: 595-598.
- Sawyer, A. J. and R. A. Casagrande. 1983. Urban pest management: A conceptual framework. *Urban Ecology* 7: 145-157.
- SAS Institute. 1985. *SAS user's guide: Statistics*. SAS Institute, Cary, N.C.
- Thoms, E. M. and W. H. Robinson. 1986. Distribution, seasonal abundance, and pest status of the oriental cockroach (Diptera: Blattellidae) and an evaniid wasp (Hymenoptera: Evaniidae) in urban apartments. *J. Econ. Entomol.* 79: 431-436.
- Woo, Fo-ching. 1981. Blattoptera: Corydidae, Blattellidae, Panesthiidae. *Insects of Xizang (Tibet)*. 1: 57-61.
- . 1982. Species of the genus *Periplaneta* Burmeister from China, with reference to their bionomics and economic importance (Blattaria: Blattellidae). *Acta Entomologica Sinica* 25: 416-422.
- . 1987. Investigations on domiciliary cockroaches from China. *Acta Entomologica Sinica*. 30: 430-438.
- Woo, Fo-ching and Yu-yuan Guo. 1984. The specific identification, distribution, bionomics, and economic importance of the genus *Blattella* Caudell (Blattaria: Blattellidae) from China. *Acta Entomologica Sinica* 27: 439-443.
- Wood, F. E., W. H. Robinson, S. K. Kraft, and P. A. Zungoli. 1981. Survey of attitudes and knowledge of public housing residents toward cockroaches. *Bull. Entomol. Soc. Amer.* 27: 9-13.
- Zungoli, P. A. and W. H. Robinson. 1984. Feasibility of establishing an aesthetic injury level for German cockroach pest management programs. *Environ. Entomol.* 13: 453-458.